

Barriers to Municipal Planning for Pedestrians and Bicyclists in North Carolina

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BACKGROUND The Guide to Community Preventive Services recommends implementing community- and street-scale urban design, as well as land use policies and practices, to promote walking and bicycling. To better understand barriers to municipal walking and bicycling projects and policies, we surveyed municipal staff in North Carolina.

METHODS We surveyed all 121 municipalities with at least 5,000 persons, and 62% responded. We also surveyed 216 of 420 municipalities with less than 5,000 persons, and 50% responded. The municipal staff member most knowledgeable about walking and bicycling planning was asked to complete the survey. Responses were weighted to account for the sampling design, to reflect prevalence estimates for all North Carolina municipalities.

RESULTS Common barriers to walking and bicycling projects and policies were selected from a 14-item list. For walking, barriers included lack of funding (93% of responding municipalities), other infrastructure priorities (79%), automobile infrastructure priorities (66%), and staffing challenges (65%). For bicycling, barriers included lack of funding (94% of responding municipalities), other infrastructure priorities (79%), automobile infrastructure priorities (73%), issues were not high priorities for the municipality (68%), staffing challenges (68%), and insufficient support from residents (63%). Barriers generally were more prevalent among rural municipalities than among urban municipalities (9 of 14 barriers for walking and 5 of 14 for bicycling; $P < .10$).

LIMITATIONS The study relied on 1 respondent to report for a municipality. Additionally, job titles of respondents varied with municipality size.

CONCLUSIONS Health professionals and multidisciplinary partners can assist in overcoming the common local- and state-level barriers to walking and bicycle projects and policies that are reported by North Carolina municipalities.

Walking and bicycling for recreation or transportation contribute to numerous health benefits [1-5]. For example, a meta-analysis of walking found that approximately 8 metabolic equivalent-hours/week (approximately 30 minutes/day for 5 days/week) of walking was associated with a 19% reduction in the risk of coronary heart disease [2]. In another meta-analysis, walking and bicycling for commuting were associated with an 11% reduction in the risk of cardiovascular disease [5]. Other benefits include reductions in the risk of asthma, obesity, diabetes, depression, and some cancers; increases in quality of life; lower carbon emissions and reduced traffic congestion; lower fuel bills and health care costs; and opportunities to reduce health disparities. In addition, areas with facilities for walking and bicycling have higher property values.

Despite the benefits of walking and bicycling, adults and youth in North Carolina often do not reach recommended physical activity levels. In 2009, 17% of North Carolina adults reported any walking or bicycling for transportation, such as to or from work or shopping, during the past week, and 26% reported no leisure activities or exercises during the past month [6], a prevalence similar to the 2009 national average of 24% [7]. By use of a national data source, North Carolina ranked poorly (43rd among states) for the percentage of adults who walked or bicycled for transportation, compared with the rest of the nation [8]. Moreover, for 2005-2007, North Carolina ranked 43rd for walker safety

and 47th for bicyclist safety [8].

The lack of physical activity also extends to North Carolina youth. In 2009, 40% of North Carolina middle school students and 54% of North Carolina high school students did not report at least 60 minutes of physical activity for at least 5 of the previous 7 days [9, 10]. Furthermore, in 2009, among North Carolina middle school students, only 19% reported walking or bicycling to school at least 1 day per week [9]. The burden of physical inactivity and its associated effects on obesity and other health-related conditions [10] generate enormous costs for youth and adults. Billions are spent annually in North Carolina on medical costs, workers' compensation claims, and lost productivity related to these conditions [11], and this is projected to increase with rising obesity [7].

In working to improve physical activity levels, researchers and practitioners increasingly have relied on the ecologic framework [12, 13], which describes how intrapersonal, interpersonal, institutional or organizational, policy, and community or environmental characteristics can influence

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physical activity levels. Traditionally, physical activity interventions have focused on the intrapersonal and interpersonal domains; however, more recently, practitioners have focused on the policy and environmental domains and on interventions that span all levels of the framework. When promoting physical activity to their patients, health care professionals can consider broad policy and environmental contexts in which physical activity occurs. For example, physicians encouraged physical activity in specific locations by writing patients prescriptions to walk that included recommendations of places to go, which involved careful consideration of the environment [14]. In another example pertaining to the environmental context, Estabrooks and colleagues [15] designed an intervention that recruited patients through physician offices and connected them to physical activity resources near their homes and workplaces.

Because physical environments and policies are likely to influence physical activity levels, we surveyed North Carolina municipalities to determine barriers to pedestrian and bicycling projects and policies. We also explored whether these barriers differed between urban areas and rural areas, to inform context-appropriate strategies for individuals working with communities. We surveyed municipalities, rather than counties, since roads outside of municipalities are owned and maintained by the North Carolina Department of Transportation [16].

Methods

Sample. We classified the 541 North Carolina municipalities by their July 2006 population, estimated from 2000 US Census data, and surveyed all 121 municipalities with at least 5,000 persons. From the 420 municipalities with less than 5,000 persons, we drew a random sample of 50%. During 2008, we also collected all North Carolina pedestrian and bicycle plans, as described elsewhere [17, 18]. Smaller municipalities with a pedestrian or bicycle plan were also included in the survey, for a total of 216 municipalities of the possible 420 municipalities with a population of less than 5,000.

Survey. For each municipality, the survey targeted the municipal staff member most knowledgeable about walking and bicycling issues. To our knowledge, no comprehensive list of planners or other contact persons exists for all municipalities in North Carolina. Therefore, we used multiple strategies, including the use of planning-association lists, Web site searches, and telephone calls to the municipality, to find the appropriate people to invite to complete the survey. The survey was available by mail and on a Web site in spring 2009. We made several attempts to contact nonresponders.

To assess barriers to walking and bicycling in the community, we asked respondents 2 questions. The first focused on walking: "What barriers do you face in terms of implementing projects, policies, or programs to support walking in your locality?" The question on bicycling was similarly worded. Both had 14 different items for response. The response options for each item included "strongly disagree,"

"disagree," "agree," and "strongly agree," which were collapsed during analysis into "agree" and "disagree." We also reviewed open-ended responses to the "other" category.

Statistical analysis. Survey responses were weighted to account for the sampling design and to reflect statewide prevalence estimates for all municipalities. The prevalence is reported using weighting only; as in most cases, the unweighted prevalence was quite similar to the weighted prevalence. We compared survey respondents to nonrespondents, using the Wald χ^2 test, with US Census data on the municipalities.

To explore differences between rural areas and urban areas, we stratified the results by population size (ie, <5,000 persons vs \geq 5,000 persons), extending from the process we used to weight the data; the categories are hereafter referred to as "rural" and "urban." When we explored the validity of this definition, we found that 381 (91%) of 420 municipalities with a population of less than 5,000 were classified as rural (ie, they fell outside of the boundary of an urbanized area) on the basis of the 2000 US Census definition [19]. SAS, version 9.2 (SAS Institute), was used for all analyses.

Results

Among municipalities with a population of at least 5,000 persons, 75 (62%) of 121 responded to the survey. Among municipalities sampled with a population of less than 5,000 persons, 108 (50%) of 216 responded to the survey. Respondents and nonrespondents were not different by region of North Carolina, urban area, percentage of residents who bicycle to work, household income, or income below the poverty level (Table 1). However, respondents were more likely to represent municipalities with a population of at least 5,000 persons and a lower proportion of residents who walked to work, compared with nonrespondents.

Among all respondents, 141 (77%) completed the survey by use of the Web site, and 42 (23%) completed it by use of a paper copy returned via mail. Respondents had been in their current position for a median of 62 months (interquartile range, 31-104 months).

Barriers to implementing walking and bicycling projects and policies are reported in Tables 2 and 3, respectively. Frequently reported barriers to walking projects and policies included lack of funding (93%), other infrastructure priorities (79%), automobile infrastructure priorities (66%), and staffing challenges (65%). Frequently reported barriers to bicycling projects and policies included lack of funding (94%), other infrastructure priorities (79%), automobile infrastructure priorities (73%), issues were not high priorities for the municipality (68%), staffing challenges (68%), and insufficient support from residents (63%). Answers provided in the open-ended response field included other barriers to these projects, such as the challenge of obtaining right-of-way, a need to retrofit roads to accommodate walkers and bicyclists, and inadequate driver education. Policy barriers included language in planning tools or docu-

TABLE 1.
Characteristics of North Carolina Municipalities That Did or Did Not Respond to the Survey

Characteristic	Respondents, no. (%) (N = 183)	Nonrespondents, no. (%) (N = 154)	P ^a
Region			
Mountain	28 (15.3)	25 (16.2)	.81
Piedmont	80 (43.7)	67 (43.5)	.97
Coastal	75 (41.0)	62 (40.3)	.89
Population ^b			.03
≥5,000 persons	75 (41.0)	46 (29.9)	
<5,000 persons	108 (59.0)	108 (70.1)	
Urban area ^c			.10
Yes	13 (7.1)	5 (3.3)	
No	170 (92.9)	149 (96.7)	
Residents aged ≥16 y who, in past week, usually bicycled to work ^d			.48
>0%	71 (38.8)	54 (35.1)	
≤0%	112 (61.2)	100 (64.9)	
Residents aged ≥16 y who, in past week, usually walked to work ^d			.04
>16.5%	82 (44.8)	86 (55.8)	
≤16.5%	101 (55.2)	68 (44.2)	
Household income ^d			.26
>\$32,279	98 (53.5)	73 (47.4)	
≤\$32,279	85 (46.5)	81 (52.6)	
Household income below poverty level ^d			.79
>14.4%	93 (50.8)	76 (49.4)	
≤14.4%	90 (49.2)	78 (50.6)	

^aCalculated by means of the Wald χ^2 test.

^bEstimated for July 2006 on the basis of 2000 US Census data.

^cDefined as areas with a population of ≥50,000 persons, as determined by the 2000 US Census.

^dCutpoints are median values for the state and were calculated on the basis of 2000 data from all 541 North Carolina municipalities.

ments, such as ordinances, which limited activities.

For 3 of 14 items, the prevalence of the bicycling barrier was at least 10% higher than that of the walking barrier. Barriers generally were more prevalent among rural municipalities than among urban municipalities (9 of 14 for walking and 5 of 14 for bicycling; $P < .10$). The only exception was the report of lack of funding for bicycle projects, which was higher among urban municipalities, compared with rural municipalities (97% vs 92%).

Discussion

There are multiple statewide efforts to increase physical activity by creating supportive policies and environments. These include the North Carolina plan to address overweight and obesity in communities [20]; the Eat Smart, Move More NC blueprint for changing environments and policies, to increase physical activity [21]; the North Carolina Institute of Medicine objectives for 2020 [22]; and the North Carolina walking and bicycling long-range transportation plan [23]. Examples of relevant North Carolina health-related projects and collaboratives relevant to these goals are summarized

in Table 4. In support of these statewide efforts, the present study documented barriers to implementing walking and bicycling projects and policies among North Carolina municipalities. We found a high prevalence of many barriers overall and a greater frequency of barriers for bicycling than for walking, as well as a greater frequency for rural areas than for urban areas. The discussion highlights opportunities for health professionals, with regards to these issues.

From the survey list, the most commonly selected barrier for walking and bicycling projects was a lack of funding (93% for walking and 94% for bicycling). In North Carolina, the Transportation Improvement Program (TIP) provides funding for these projects [24]. The TIP is a financially constrained 2-year plan of investments managed by metropolitan planning organizations (MPOs), rural planning organizations (RPOs), and the North Carolina Department of Transportation. In 2008, North Carolina had 17 MPOs (available at: <http://www.ncdot.org/doh/preconstruct/tpb/mpo/mpo.html>) and 20 RPOs (available at: <http://www.ncdot.org/doh/preconstruct/tpb/mpo/rpo.html>). MPOs are federally designated and funded regional institutions that con-

TABLE 2.
Barriers to Implementing Walking Projects and Policies Among North Carolina Municipalities, Overall and by Population Size

Barrier	Overall (N = 183)	≥5,000 residents (N = 75)	<5,000 residents (N = 108)	P ^a
Funding and staffing				
There is not enough funding to address these issues	92.6 ± 1.8	94.6 ± 2.1	91.8 ± 2.3	.37
There are staffing challenges to addressing pedestrian issues (eg, not enough staff capacity, staff do not have enough time)	65.3 ± 3.1	52.1 ± 4.8	70.4 ± 3.8	.003
Infrastructure priorities				
Other infrastructure priorities (eg, water, sewer) take precedence over pedestrian issues	79.3 ± 2.6	68.9 ± 4.4	83.2 ± 3.1	.01
Auto infrastructure needs take precedence over pedestrian issues	65.5 ± 3.1	64.9 ± 4.5	65.8 ± 3.9	.88
Community, regional, and state support				
There is not enough support for these issues from regional or state agency officials or policymakers	54.9 ± 3.3	46.5 ± 4.8	58.0 ± 4.1	.07
These issues are not a high-priority topic for my jurisdiction at this time	57.2 ± 3.2	28.2 ± 4.4	67.7 ± 3.8	<.001
There is not enough support for these issues from residents of my jurisdiction	52.1 ± 3.3	23.6 ± 4.1	62.7 ± 4.0	<.001
The local pedestrian needs conflict with regional needs or priorities	35.7 ± 3.2	30.1 ± 4.4	37.8 ± 4.1	.20
There is not enough support for these issues from local agency officials or policymakers (eg, mayor, town manager)	36.0 ± 3.2	17.6 ± 3.6	43.0 ± 4.1	<.001
Land use and development				
The current land use patterns do not support walking	43.4 ± 3.2	44.4 ± 4.8	43.0 ± 4.1	.82
Development pressure makes it difficult to address these needs	34.4 ± 3.2	25.7 ± 4.1	37.8 ± 4.1	.04
Policies				
The policies/regulations specified by other North Carolina state plans do not support walking	26.6 ± 2.9	29.6 ± 4.4	25.4 ± 3.7	.47
The policies/regulations specified by other local plans do not support walking (eg, comprehensive land use plan, subdivision ordinances, transportation plan)	25.9 ± 3.0	9.7 ± 2.8	32.1 ± 3.9	<.001
The policies/regulations specified by other regional plans (eg, RPO/MPO ^b plans) do not support walking	21.9 ± 2.8	13.7 ± 3.3	25.1 ± 3.6	.02

Note. Data are weighted percentage ± standard error.

^aCalculated by means of the Wald χ^2 test.

^bSee the Discussion section for definitions of North Carolina metropolitan planning organizations (MPOs) and rural planning organizations (RPOs).

duct transportation planning in all metropolitan areas of the United States. RPOs are transportation planning organizations in North Carolina that provide a forum for rural transportation issues and policies and work in coordination with the state government and the MPOs, though they are not federally mandated. Walking and bicycling projects typically are funded by the “transportation enhancements” funding category, for which law requires that 10% of federal funds under the Surface Transportation Program must be set aside. On the basis of 2004-2008 data, 1.2% of federal transportation dollars were spent on walking and bicycling projects in North Carolina [8].

Secondary sources of money for walking and bicycling projects include a municipality’s budget (eg, funds generated through local bonds and general revenue sources). Another funding option is through the North Carolina Department of Transportation, which administers the portion of the state gas tax that is returned to localities (referred to as State Street Aid or Powell Bill funding). The fund was established to assist municipalities in constructing and maintaining

roadways within their jurisdictions, and, since 1994, it has included the planning, construction, and maintenance of sidewalks and bikeways. Last, private sources and external grants may provide funding for walking and bicycling projects. From our previous analysis of North Carolina pedestrian plans, we found that urban and rural municipalities identified similar funding sources for walking projects [25].

Designing roads to accommodate walkers and bicyclists and, where appropriate, building separate facilities for these users promises to be an effective strategy to increase physical activity among North Carolina residents. In 2007, 60% of North Carolina adults reported that they would be likely to increase their physical activity if their communities had more accessible sidewalks or trails for walking or bicycling [26]. Despite this, approximately two-thirds of the survey respondents selected staffing as a challenge to addressing walking and bicycling issues, and at a prevalence much higher in rural areas than in urban areas. Walking and bicycling issues may be one of many items for which a single staff person in a smaller municipality is responsible. Competing demands

TABLE 3.
Barriers to Implementing Bicycling Projects and Policies Among North Carolina Municipalities, Overall and by Population Size

Barrier	Overall (N = 183)	≥5,000 residents (N = 75)	<5,000 residents (N = 108)	P ^a
Funding and staffing				
There is not enough funding to address these issues	93.7 ± 1.6	97.3 ± 1.5	92.4 ± 2.1	.07
There are staffing challenges to addressing bicyclist issues (eg, not enough staff capacity, staff do not have enough time)	68.4 ± 3.0	56.3 ± 4.8	72.9 ± 3.7	.01
Infrastructure priorities				
Other infrastructure priorities (eg, water, sewer) take precedence over bicyclist issues	78.9 ± 2.6	72.6 ± 4.3	81.2 ± 3.2	.11
Auto infrastructure needs take precedence over bicycling issues	72.9 ± 2.9	75.3 ± 4.1	72.0 ± 3.7	.55
Community, regional, and state support				
There is not enough support for these issues from regional or state agency officials or policymakers	50.6 ± 3.2	41.7 ± 4.7	53.8 ± 4.0	.05
These issues are not a high-priority topic for my jurisdiction at this time	68.1 ± 2.9	50.0 ± 4.7	74.9 ± 3.5	<.001
There is not enough support for these issues from residents of my jurisdiction	63.2 ± 3.1	40.3 ± 4.7	71.6 ± 3.7	<.001
The local bicyclist needs conflict with regional needs or priorities	37.3 ± 3.2	42.9 ± 4.8	35.2 ± 3.9	.22
There is not enough support for these issues from local agency officials or policymakers (eg, mayor, town manager)	51.3 ± 3.2	31.1 ± 4.4	58.9 ± 4.0	<.001
Land use and development				
The current land use patterns do not support bicycling	47.0 ± 3.3	43.8 ± 4.7	48.2 ± 4.1	.49
Development pressure makes it difficult to address these needs	41.8 ± 3.2	35.6 ± 4.6	44.1 ± 4.1	.17
Policies				
The policies/regulations specified by other North Carolina state plans do not support bicycling	29.7 ± 3.0	31.4 ± 4.5	29.1 ± 3.8	.69
The policies/regulations specified by other local plans do not support bicycling (eg, comprehensive land use plan, subdivision ordinances, transportation plan)	31.4 ± 3.1	17.8 ± 3.7	36.6 ± 4.0	<.001
The policies/regulations specified by other regional plans (eg, RPO/MPO ^b plans) do not support bicycling	22.3 ± 2.8	16.9 ± 3.6	24.3 ± 3.6	.15

Note. Data are weighted percentage ± standard error.

^aCalculated by means of the Wald χ^2 test.

^bSee the Discussion section for definitions of North Carolina metropolitan planning organizations (MPOs) and rural planning organizations (RPOs).

for a staff person's attention create challenges to prioritizing walking and bicycling issues. There is opportunity for health professionals with overlapping interests to provide support.

Approximately two-thirds to three-fourths of respondents agreed that automobile and other infrastructure priorities take precedence over walking and bicycling issues in their municipalities. Additionally, one-half to two-thirds of respondents reported a lack of support for these issues locally, regionally, and at the state level. Bicycling issues garnered less support than walking issues, especially at the local level. Reported lack of support was much higher among rural municipalities than among urban municipalities.

Health professionals are well-positioned to communicate the relationships between environmental attributes, walking and bicycling, and chronic disease with town officials, local policymakers, and community-based organizations, whether in the role of medical experts or as residents. Specifically, they could become members of local commissions on planning, parks and recreation, bicycling, walking, or health. Health professionals could speak at public forums

or join standing committees and provide feedback as plans or policies are proposed or amended. They could bring health to the forefront by identifying the problems of obesity and the lack of physical activity and by championing positive changes [27]. Health professionals could also assist local advocacy groups to become more involved in the municipal or county system, to affect infrastructure priorities and support. They could also consider regional or statewide involvement by working with regional or state departments or advocacy groups, such as those specified in Table 4, to address issues on walking and bicycling.

When asked whether development pressure makes it difficult to address walking and bicycling issues, 34% of respondents answered affirmatively for walking, and 47% answered affirmatively for bicycling. Development pressure in the form of policies that promote sprawl can complicate a local jurisdiction's efforts to address walking and bicycling issues [28]. In Table 5, we describe examples of tools local communities may use to encourage walking and bicycling. They include a mix of strategies, guidelines, and programs

TABLE 4.
Select Recent Health-Related Programs and Collaboratives in North Carolina That Are Addressing Built Environment and/or Policy Barriers to Walking and Bicycling

Program	Description	Web site
Communities Putting Prevention to Work	With federal funding from the American Recovery and Reinvestment Act, this project focuses in 11 NC communities and at the state level, to impact active living through the media, access, point of purchase, price, and social support.	http://www.cdc.gov/CommunitiesPuttingPreventiontoWork/
Eat Smart, Move More NC	A statewide partnership of more than 60 member organizations dedicated to improving physical activity and diet in NC, to enable residents to move more, eat smart, and achieve a healthy weight. This partnership includes local coalitions and grant programs.	http://eatsmartmovemorenc.com/
Fit Community Program	This initiative was developed by the NC Health and Wellness Trust Fund, in collaboration with Active Living by Design, to recognize and reward NC municipalities and counties that excel in supporting physical activity, healthy eating, and tobacco-use prevention in the community, schools, and workplaces.	http://www.fitcommunitync.com
Healthy Environments Collaborative	This is a collaboration of 4 state departments: Health and Human Services, Transportation, Commerce, and Environment and Natural Resources. The mission is to integrate and influence interdepartmental efforts to improve the health of NC people, environments, and economy.	http://nchealthyenvironments.com
Investigating Places for Active Recreation in Communities	This initiative seeks to advance the science of how parks, recreation, and sport environments promote active living and to facilitate the application of evidence-based policies and practices, to enhance opportunities for physical activity.	http://cnr.ncsu.edu/iparc/
NC Action for Healthy Kids	The mission of this program is to improve children's physical activity and nutrition in schools by collaborating with diverse stakeholders in advocating, promoting, and implementing national and state initiatives.	http://www.ncactionforhealthykids.org/
NC Healthy Schools	This program seeks to create a working infrastructure between education and health, to enable schools and communities to create a coordinated school health program.	http://www.nchealthyschools.org
NC Physical Activity Policy Research Center	Since 2004, the center has studied the development, implementation, and effectiveness of policies related to increasing physical activity in communities.	http://prcstl.wustl.edu/research/Pages/PAPRN.aspx
NC Planning Grant Initiative	An annual matching grant program supported by the NC Department of Transportation, to encourage municipalities to develop pedestrian and bicycle plans.	http://www.ncdot.org/bikeped/planning/
NC Prevention Partners	A statewide nonprofit working to reduce preventable illness and early death caused by physical inactivity, poor nutrition, and tobacco use.	http://www.ncpreventionpartners.org
NC Statewide Health Promotion Program	This program funds 85 local health departments and districts, to support community-based programs promoting policy and environmental changes that will support increased physical activity, healthy eating, and tobacco-use cessation.	http://www.ncpanbranch.com/SWHP.html
NC Safe Routes to School	This program enables community leaders, schools, and parents to improve safety and encourage more children to safely walk and bicycle to school.	http://www.saferoutesinfo.org

Note. All Web sites were accessed March 7, 2011.

that alternately help raise capital or address future land development.

Respondents reported that 26% and 31% of policies or regulations in local plans do not support walking and bicycling, respectively. For both walking and bicycling, the prevalence was much higher in rural municipalities than in urban municipalities. This may reflect conventional land use patterns and development policies in rural areas, which, since the mid-1900s, have emphasized low-density, auto-oriented growth and have not yet been updated with policies to support active living [39].

Some North Carolina communities integrate pedestrian and bicycle planning into local plans, such as transportation, land use, greenway, or park plans. Stand-alone pedestrian and bicycle plans are other avenues local governments can use to help create environments that support walking and biking. Such plans explain a community's vision and goals for future

activity; address relevant policies, programs, and facilities; and identify changes to laws and regulations that could enable residents to integrate walking and bicycling into daily routines. These plans also may set goals and benchmarks toward a more pedestrian- and bicycle-friendly community. In North Carolina, pedestrian and bicycle plans are less prevalent in rural areas than in urban areas and are less prevalent in places with smaller populations than in places with larger populations [25]. A majority of communities in North Carolina have neither type of plan [17]. In 2004, to encourage local entities to develop stand-alone pedestrian or bicycle plans, the North Carolina Department of Transportation's Division of Bicycle and Pedestrian Transportation and Transportation Planning Branch initiated a competitive grant program to encourage municipalities to develop pedestrian and bicycle plans [40]. The funding has continued yearly, helping municipalities develop or update pedestrian or bicycle plans.

TABLE 5.
Select Strategies and Tools That Can Impact Walking and Bicycling in Municipalities

Strategy/tool	Description
Capital improvement program	A 5- to 6-year schedule of capital projects [29]. Capital planning involves the purchase or construction, major repair, reconstruction, or replacement of capital items, such as buildings, utility systems, roadways, bridges, parks, landfills, and heavy equipment.
Complete streets	A policy and related guidance on how to design streets to be safe for all users, including pedestrians, bicyclists, transit riders, motorists, and individuals of all ages and capabilities. The NC Department of Transportation Complete Streets Act of 2009 is part of a national movement that includes the federal Complete Streets Act of 2009. More information is available on NC (http://www.nccompletestreets.org/policy.asp) and the United States (http://www.completestreets.org/federal-policy/).
Concurrency requirements	An attempt to manage the timing of development so that it coincides with the availability of infrastructure capacity for community facilities, such as water, sewer, and transportation [30].
Crime Prevention Through Environmental Design	An evidence-based law enforcement strategy that attempts to build partnerships with residents and stimulate collective efficacy to solve problems [31]. It works through design and management of the physical environment of buildings, residential neighborhoods, and business areas, to increase public safety and reduce fear of crime. Additionally, community policing programs, by making police more visible and familiar to residents and with the physical environment of their beats, reinforce these efforts and promote police-citizen partnerships to prevent crime and disorder, which affects public health.
Health impact assessment	A set of procedures, methods, and tools by which a policy, program, or project may be judged for its potential effects on the health of a population and the distribution of those effects within the population [32].
Impact fees	Usually a single-time fee or charge on new development projects that is imposed by local government to cover capital expenditures on the infrastructure required to serve the new development [29]. In NC, impact fees are legal with prior General Assembly approval [33].
Joint-use agreement	A joint-use agreement is a formal agreement between 2 separate government entities that sets forth terms and conditions for shared use of public property or facilities (http://www.nplanonline.org/nplan/joint-use). An example is a joint-use agreement between a school and a city to use physical activity facilities.
Land trusts	A private nonprofit organization that has received a designation from the Internal Revenue Service as a 501(c)(3) corporation involved in charitable and educational activities [29]. It is common practice for land trusts to purchase open space and then to sell it to local and state governments for park land.
Mixed land uses	Mixed-use developments seek to create pedestrian-friendly environments, higher-density development, and a variety of uses that enable people to live, work, play, and shop in one place, which can become a destination [29].
Plans, such as pedestrian and bicycle plans	An adopted official statement of a local government that sets forth, in a public document, the community's vision and goals for future walking and bicycling. The plan may be called a comprehensive plan, general plan, or master plan [34, 35].
Public transportation	Transportation by bus, rail, or other conveyance, either publicly or privately owned, which provides to the public general or special service on a regular and continuing basis [36]. Also known as mass transportation, mass transit, and transit.
Safe Routes to School	A program that provides funding to enable and encourage children to walk and bicycle safely to and from school (http://www.saferoutesinfo.org/).
Smart growth	Development that changes the terms of the development debate away from the traditional growth/no growth question to how and where new development should be accommodated. Principles include (1) mixed land uses, (2) taking advantage of compact building design, (3) creating a range of housing opportunities and choices, (4) creating walkable neighborhoods, (5) fostering distinctive and attractive communities with a strong sense of place, (6) preserving open space, farmland, natural beauty, and critical environmental areas, (7) strengthening and directing development toward existing communities, (8) providing a variety of transportation choices, (9) making development decisions predictable, fair, and cost-effective, and (10) encouraging community and stakeholder collaboration and development decisions [35].
Site design guidelines	A set of guidelines by a jurisdiction that must include provisions that address the needs of walkers, transit patrons, and bicyclists, especially in light of the Americans with Disabilities Acts and federal transportation legislation that supports multiple modes of transportation [29].
Subdivision ordinance	A regulation that controls the division of a tract of land for building and development purposes. It includes standards for the design and layout of lots, streets, utilities, and other public improvements, as well as procedures and requirements to ensure that public improvements are available when it is time to build on the lots [29].
Traffic calming	Using physical measures and barriers to deliberately reduce traffic speed and traffic volume, to make streets safer.
Transfer or purchase of development rights	The yielding of some or all of the right to develop or use another parcel of land or another portion of the same parcel of land more intensively [29]. When local governments or nonprofit organizations purchase development rights, the land stays in private ownership.
Transportation improvement program	A prioritized program or listing of transportation projects that is developed and formally adopted by a metropolitan planning organization as part of the metropolitan transportation planning process [37].
Universal design	Architectural planning designs that are intended to produce buildings and environments that are accessible to both able-bodied and disabled individuals [38]. Examples include sidewalk ramps and curb cuts.
Zoning ordinance	A legal document that describes each zoning district and the uses that may be allowed within the district [35].

Many North Carolina pedestrian and bicycle plans integrate health into their goals [34]. The degree to which the goals are met remains unknown. However, communities with plans that address walking and bicycling may have, over time, more infrastructure for walking and bicycling in the community that can, in turn, contribute to more physical activity and lower obesity rates. For example, in North Carolina, municipalities with local pedestrian plans had higher percentages of workers walking or bicycling to work than did areas without such plans [25]. Others have found that having a local pedestrian or bicycle plan increases the likelihood that walking and bicycling projects will be included in the TIP, which guides most state construction or reconstruction projects [41].

Health professionals and researchers alike can convey the possible health impacts of plans and policies, help institutionalize the role of health in ongoing planning, and ensure that health considerations are addressed in development decisions [27, 41, 42]. Additionally, with innovative approaches to the integration of primary care and preventive medicine included in the Affordable Care Act [43], primary care professionals could propose policy and environmental changes that promote better patient outcomes. Kingdon's framework on policy change [44], and examples of its implementation [45], lend support to this approach. Additionally, hospitals and health care facilities in several states are leading efforts to develop more supportive environments and policies for healthy lifestyles in their catchment areas. Regardless of the forum or role, a helpful initial step for health professionals may be to gain familiarity with relevant municipal, county, and state plans and policies, as well as their implementation processes.

Several respondents mentioned in the open-ended questions that state policies and practices could better support walking or bicycling in projects. Here, too, there is a role for health professionals. Those who communicate with state-level officials—be it on a committee, as part of a working group, or in some other way—have opportunities to convey many important health benefits associated with removing these barriers.

Our findings are subject to several limitations. First, respondent occupations varied across municipalities and included, for example, planners, planning directors, public works directors, and town managers. This reflects the diversity of job functions and positions across municipalities. In an effort to maintain consistency, the survey was targeted to the staff person most appropriate to talk about municipal pedestrian and bicycle planning. Second, some prevalence estimates had wide confidence intervals, as indicated by higher standard errors. The survey was weighted to represent all municipalities in the state of North Carolina. Nevertheless, these prevalence estimates should be interpreted in consideration of the precision of the estimates. Third, these data are subject to the potential of self-reporting bias. Fourth, we found some differences in municipalities

that responded to the survey, compared with municipalities that did not respond to the survey (Table 1). The strengths of the study included a statewide survey with estimates reflective of North Carolina municipalities on barriers to walking and bicycling projects and policies not previously explored in this way in the United States.

The present study offers a unique perspective of staff with the most knowledge about walking and bicycling, from a representative sample of North Carolina municipalities. The findings can help identify strategies for multidisciplinary partners, to address common barriers to walking and bicycling projects and policies reported by North Carolina municipalities. Health professionals, in particular, are well-positioned to take action by engaging with town officials, policymakers at all levels of governance, and community-based organizations, to support strategies that promote walking and bicycling in North Carolina. **NCMJ**

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